

## NOTES ON SOME SPECIES OF GYMNO- SPORANGIUM IN COLORADO

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[WITH PLATE 48, CONTAINING 2 FIGURES]

Colorado possesses an unusually large number of interesting cedar rusts. Nine distinct species are recognized (ten with the new species described below), which is about one third the number of the telial forms known to occur in the United States. These have been brought to notice through the careful investigations of Dr. Arthur and Prof. Kern, who have visited the state twice in search of rusts, supplemented by the work of the writer in making collections and field observations for the purpose of connecting them with their roestelia stages. Of the nine species, five have been connected with their roestelia stage through the culture work of Arthur and Kern, and, with telial material of *Gymnosporangium juniperinum* (L.) Mart. collected this spring, it is hoped that its connection with *Roestelia fimbriatum* Arthur will be established, since abundant field observations point to this relationship.

There is only one known unconnected *Roestelia*, that of the pear and quince, which is probably not related to any of the three unattached species, namely, *G. durum* Kern, *G. speciosum* Peck, and *G. multiporum* Kern, unless it be *G. durum*. For the purpose of getting culture material of these three unattached species, and especially to gather information regarding the pear and quince rust, the writer made a short visit to the southwestern part of the state during his spring vacation last month. Nothing could be learned of the pear rust, as the trees had been cut down some years ago on account of the disease. Good telial collections were made of *G. durum* and *G. inconspicuum* Kern (already connected by culture with *Roestelia Harknessianoides* Kern).

It was a great disappointment not to get culture material of *Gymnosporangium speciosum*, as noted below in discussion of *Aecidium gracilens*. However, this arduous trip of five hundred miles was amply rewarded by the discovery of an unique species, apparently undescribed, which causes the dense, globose "witches' brooms" (2 in. to 2 ft. in diameter) on the Utah cedar (*Juniperus utahensis*). The cause of these conspicuous "brooms" has been attributed to some one of the numerous insects, such as coccids, aphids, etc., which inhabit them. The writer, however, has for some years entertained the belief that they were due to a species of *Gymnosporangium* but has been unable to verify this suspicion until this spring on account of not being able to visit the region at the proper season to make collections. An examination of the "brooms" at this time revealed the fact that a small *Gymnosporangium*, somewhat resembling *G. Nelsoni*, was the cause of the fasciation, and that the presence of the insects is merely incidental, as they find convenient shelter among the compact branchlets. This interesting species, conspicuous on account of the fasciation it produces, is characterized as follows:

***Gymnosporangium Kernianum* sp. nov.**

Telia arising between the scale-like leaves, causing a fasciation of the young shoots and forming dense, globose "witches' brooms" 5-60 cm. in diameter; sori scattered, solitary, hemispheric, 0.5-0.8 mm. across, rather compact, dark reddish-brown; spores usually two-celled, narrowly ellipsoid, large,  $21-26 \times 55-74 \mu$ , only slightly or not at all constricted at the septum; wall thin, about  $1 \mu$ , yellowish, smooth; pedicel hyaline, cylindric, very long; pores usually two, near the septum.

On *Juniperus* (*Sabina*) *utahensis* (Engelm.) Lemm., Paonia, Colorado (*type*), March 28, 1911; Glenwood Springs, Colorado, March 27, 1911, *E. Bethel*. Type deposited at the New York Botanical Garden.

This species produces a very compact, perfectly spherical fasciation (see Fig. 2), the numerous branchlets becoming weaker than normal, and the scales smaller, thus differing from the fasciation of *G. Nelsoni*, in which the scales of the affected

branchlets usually become more subulate, resembling those of the younger growth (see Fig. 3). In having small and inconspicuous sori, it resembles *G. Nelsoni*, *G. multiporum* and *G. inconspicuum*. The telia of the new species in germination become obliquely conic; of *G. Nelsoni* Arth., hemispheric; and of *G. multiporum* Kern, ellipsoid-hemispheric. The sori of *G. inconspicuum* appear as a faint brownish line encircling the scales, until diliquescence, when they spread out as a thin, yellowish film. In spore characters, also, the new species differs from the above named species (see Fig. 1); *G. multiporum* has

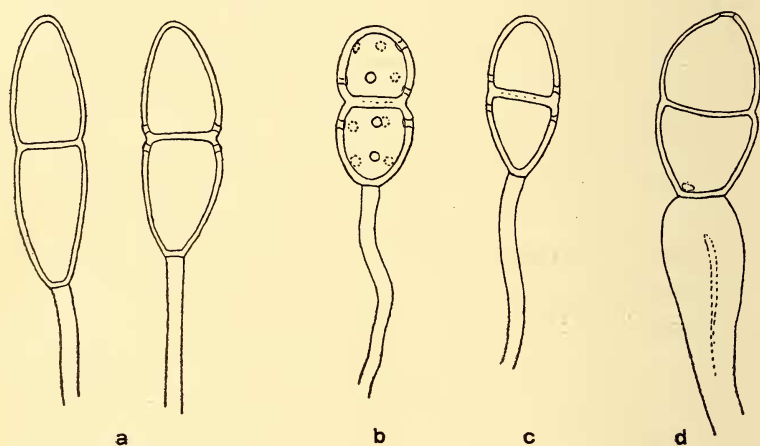


FIG. 1. Teliospores of (a) *Gymnosporangium Kernianum*, (b) *G. multiporum*, (c) *G. Nelsoni*, (d) *G. inconspicuum*, drawn to the same scale, approximately  $\times 475$ .

four scattered germ-pores, *G. inconspicuum*, one in each cell, apical in the upper and near the pedicel in the lower; *G. Nelsoni* has one or two germ-pores in each cell near the septum as in the new species, but the spores are much smaller,  $18-26 \times 39-52 \mu$ , and broadly ellipsoid, with pedicel inflated at juncture with spore.

There are no clues as to its roestelial connection, though it probably belongs to *Amelanchier* and *Peraphyllum*, which form extensive chapparal around the infected trees.

It is with especial pleasure that this species is dedicated to Prof. Frank D. Kern, who, through extensive observations in the field and painstaking culture work, has rendered invaluable

service in adding to our knowledge of the Rocky Mountain forms, which had hitherto been much confused and largely unknown.

#### NOTE ON AECIDIUM GRACILENS PECK

Specimens of this aecium on *Philadelphus occidentalis* were collected by Mr. G. E. Osterhout at Glenwood Springs, Colo., in August, 1906. It was at that time thought by the writer to be a *Roestelia* and was placed in his herbarium for future study. The specimen was forgotten and overlooked until recently when working over the roestelial forms attention was again attracted to it. An investigation of the locality where the collection was made revealed the presence of *Gymnosporangium speciosum* Peck on *Juniperus utahensis* in close proximity. This gave a suspicion that the two might be related and that *A. gracilens* Peck might prove to be a true *Roestelia*. Through the kindness of Dr. J. C. Arthur, the writer was permitted to examine authentic specimens of this form and the Glenwood specimens were found to be the same. This species, while referred to *Aecidium* by Peck, possesses many characteristics of a true *Roestelia*, among them being the elongated, membranous peridium, peridial cells loosely joined together with characteristic sculpturings on the inner and side walls, and aeciospores with evident germ-pores.

An examination was then made of the distribution of the two species, and the range, central Colorado to N. Mexico and Arizona, was found to be the same. The few collections of this rare aecidium, so far as can be learned, have been taken where *G. speciosum* abounds; likewise *Philadelphus* is common in most localities where it has been found.

In the cliff-dweller country (Mesa Verde National Park) in southwestern Colorado, near Mancos, the writer on collecting trips in 1897 and 1900 found *G. speciosum* epidemic on *Juniperus utahensis*. *Philadelphus* was very abundant but no search was made at that time for any *Roestelia* on it.

In order that the attention of collectors may be directed towards securing additional collections and data, the following

localities known to the writer for the *Aecidium* and *Gymnosporangium* are given:

A. GRACILENS Peck: on *Philadelphus microphyllus*, "Colorado," 1879, *Brandegee* (type); on *Philadelphus* sp., El Capitan Mts., Lincoln Co., New Mex., July, 1906, *Earle*; on *Philadelphus occidentalis*, Glenwood Springs, Colo., Aug., 1906, *Osterhout*.

GYMNOSPORANGIUM SPECIOSUM Peck: on *Juniperus* sp., "Colorado," *Brandegee*, (type); on *Juniperus utahensis*, Mancos, Colo., June, 1897, *Bethel*; Glenwood Springs, Colo., May 1, 1907, *Arthur & Kern*; June, 1907, *Bethel*; Paonia, Colorado, August, 1909, *Bethel*; on *Juniperus monosperma*, Cañon City, Colo., Walsenburg, Colo., Trinidad, Colo.,—all in June, 1909, *Bethel*.

The relationship of *A. gracilens* to *G. speciosum* is merely inferential and is based on field observations, distribution, and the apparent roestelial characters of the *Aecidium*. Further, the fact that sowings of *G. speciosum* have been tried unsuccessfully on *Amelanchier*, *Crataegus*, and *Sorbus* supports the inference that it may have its roestelial stage outside of the Malaceae. This would be a very interesting connection, if established, since the only known case of a *Roestelia* outside of the ligneous Malaceae is that of *G. exterum* Arth., which occurs on *Gillenia stipulacea*, an herbaceous annual of the Rosaceae, while *Philadelphus* belongs to the Hydrangiaceae. *G. speciosum* occurs in woody tissue of old branches, emerging through the bark in long longitudinal, sinuous masses of a reddish or orange color, which ultimately fade to a white color. It causes large hypertrophies, sometimes six to ten inches in diameter, superficially resembling those of *Peridermium Harknessii* Moore, on species of pine.

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